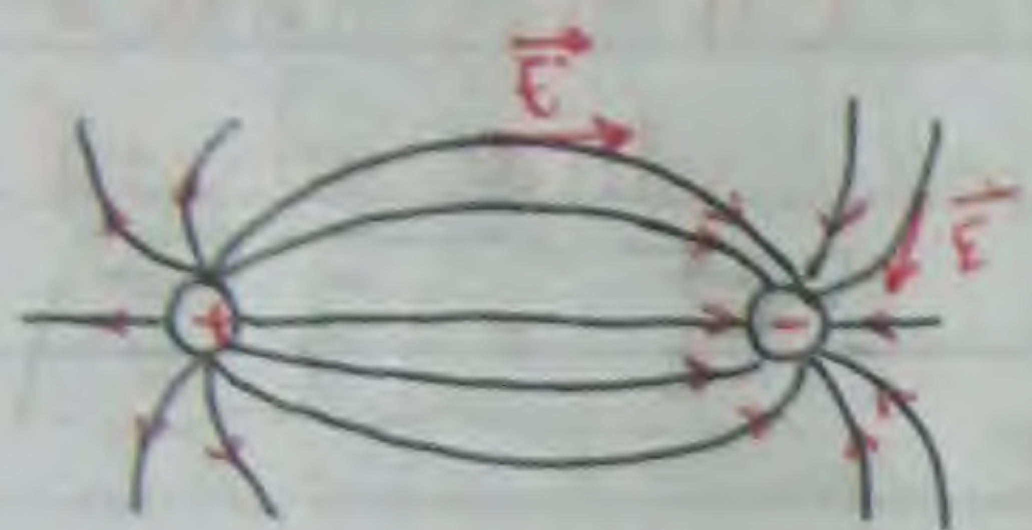
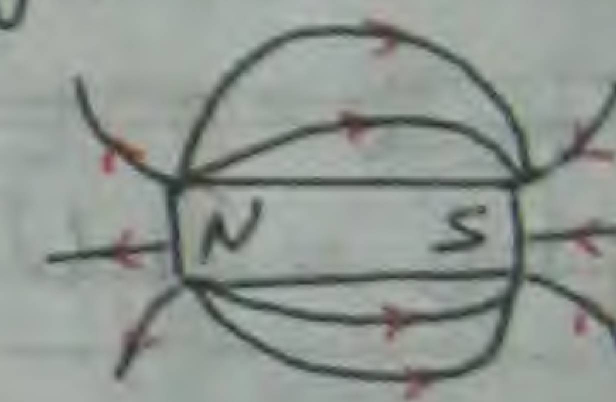
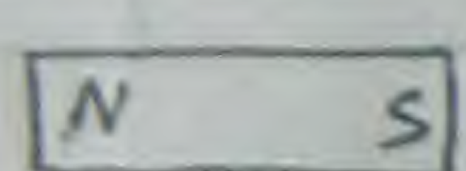
11/2/2012

→ Applications of magnetic field

1) Data storage /read/write.
2) Medical MRI (magnetic Resonance Imaging)
3) High speed train.
4) Motors.

Electric Field	Magnetic field
→ Form From static charges	→ Form From moving charges → Magnetic Materials.
	
- charges can be spearated - direction From (+ to −) and $\vec{E}$ is tangent	- Magnetic Poles can't be separated - direction From (N to S)

→ **Magnet:**



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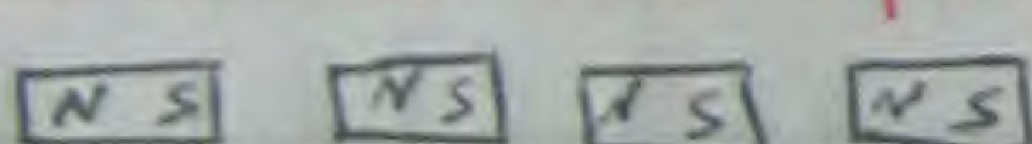
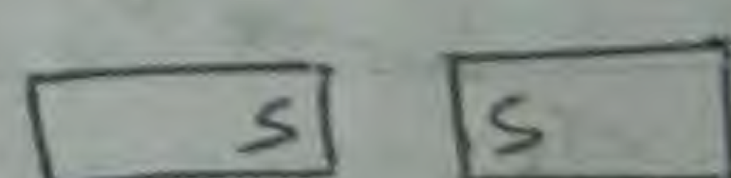


(divided into 2parts)

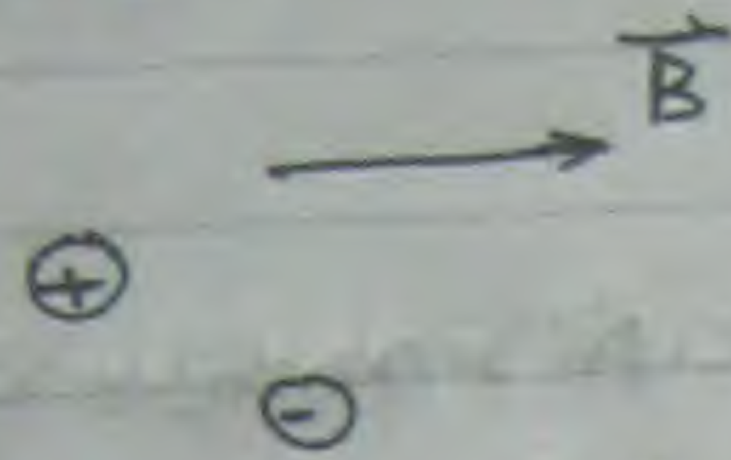
attraction



repulsion

→ Magnetic field :	→ Electric Field
$\vec{B}$: Magnetic field intensity	$\vec{E}$: electric field intensity.
unit : Tesla (T) Gauss (G) 1 Gauss = 10^{-4} Tesla	unit : V/m or N/c
$T \equiv \frac{N\,S}{C\,m}$ By ($B = \frac{F_B}{q v \sin\theta}$)	$\boxed{\frac{\vec{E}}{\vec{B}} \text{ ; Velocity}}$

Magnetic Force (F_B)



- Experimentally

- Force (F_B)

$F_B \propto q$, $F_B \propto B$

$F_B \propto v$

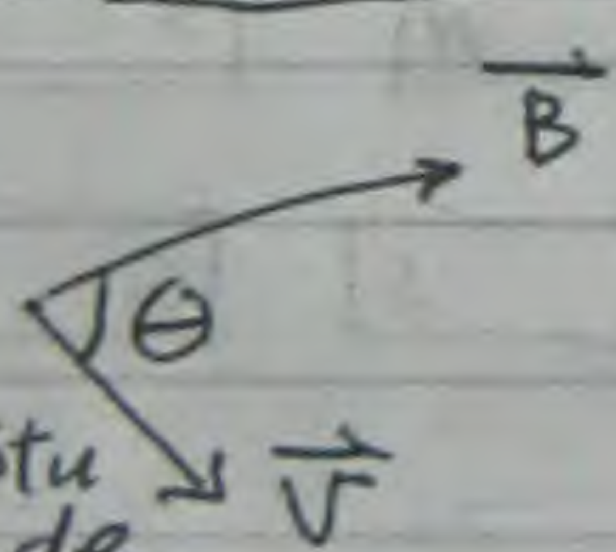
- $F_B \perp v$, $F_B \perp B$

- $\boxed{\vec{F_B} = q\vec{v} \times \vec{B}}$

. v : velosity.

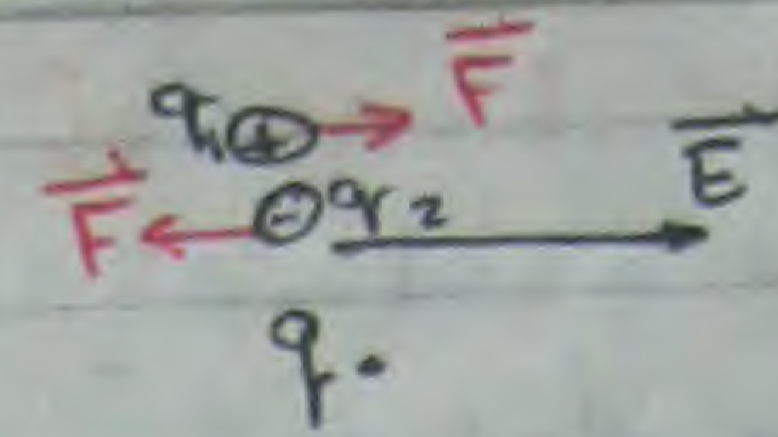
. B : magnetic Field.

$$\boxed{|\vec{F_B}| = q v B \sin\theta}$$



$\sin\theta$ ↓ To have magnitude.

Electric Force (F_E)



- a Field $\vec{E}$ with a charge q in it.
- There is a force affect the charge.
- The direction of force

(If q ⊕ in the dire. of $\vec{E}$)

(If q ⊖ in the opposite direction of $\vec{E}$)

- $\boxed{\vec{F_E} = q\vec{E}}$

- charges static or moving

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F_B

static charge

$v = 0$

then, $F_B = 0$

moving charge

$\vec{v} \parallel \vec{B}$

then, $\theta = 0$ or 180

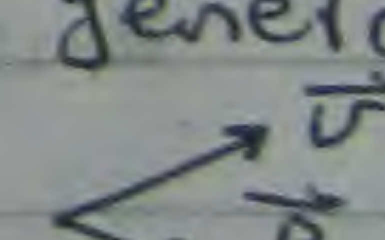
Hence, $F_B = 0$

$\vec{v} \perp \vec{B}$

then, $\theta = 90°$

Hence, $F_B = \underline{qvB}$

general



Hence,

$\underline{F_B = qvB\sin\theta}$

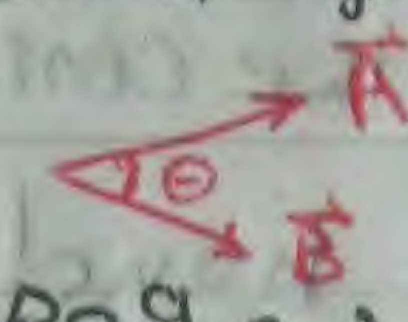
→ How to find the direction of the magnetic force?

If $\vec{C} = \vec{A} \times \vec{B}$

(direction of C by right hand role : put your hand on $\vec{A}$ like and move your

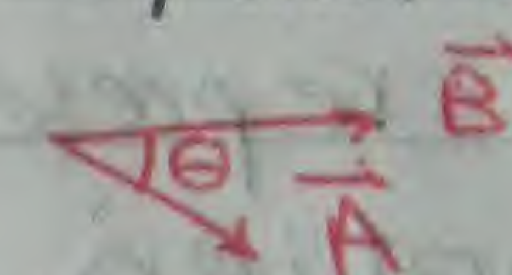
① four finger from $\vec{A}$ to $\vec{B}$ by the smaller angle then the fifth finger is towards the direction of $\vec{C}$).

(when the direction of moving from left to wirte like



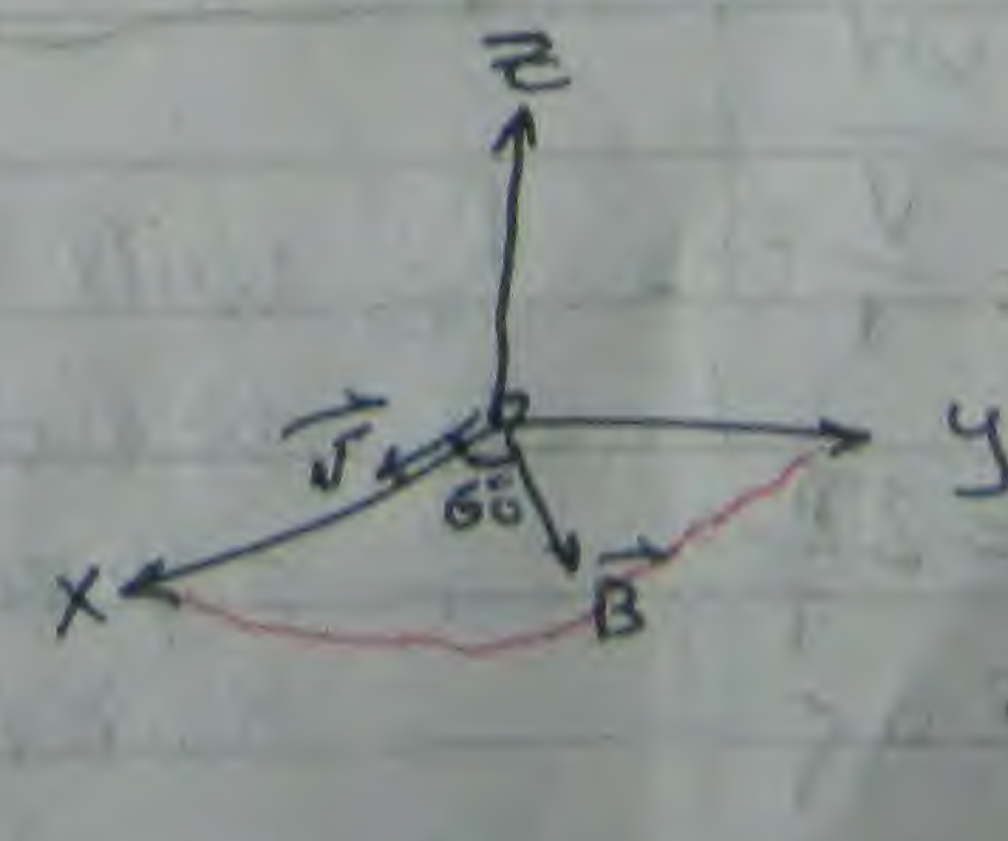
The direction is ~~inside~~ the page) sign ⊙
into

② and (when the direction of moving from right to left like



The direction is out of the page) sign ⊗

ex ① An electron in a T.V tube move foward the front of the tube with $v = 8 \times 10^6$ m/s along x axis. Taking $B = 0.025$ T directed at an angle of $60°$ to the x axis and long the xy planes. find the magnetic force acting on the electron.



$$\vec{F}_B = q\vec{v} \times \vec{B}$$

$$|\vec{F}_B| = |q| v B \sin\theta$$

$q = 1.6 \times 10^{-19}$ C, $v = 8 \times 10^6$ m/s

$B = 0.025$ T, $\theta = 60°$

$$F_B = 2.8 \times 10^{-14} \text{ N.}$$

(magnitude of magnetic force)

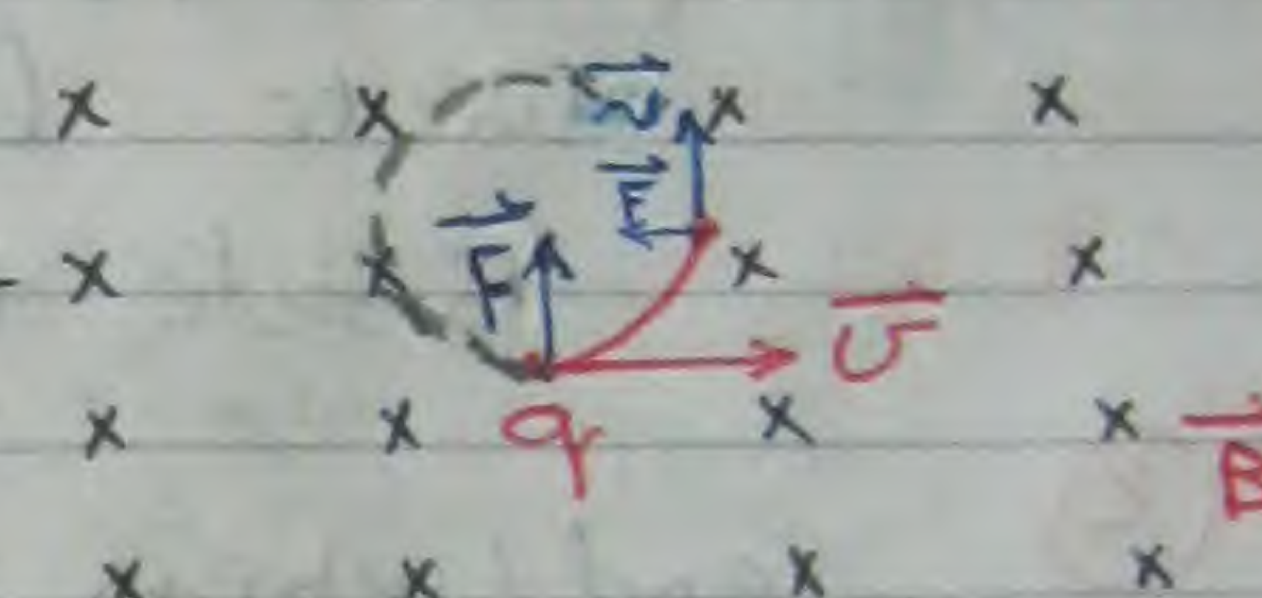
- To find the direction of $(\vec{F_B})$ in ex.
  1) use any role to find the direction.
  so, it will be in Z direction.
  2) Taking the sign of charge into consideration as it is $-ve$ so $(\vec{F_B})$ is directed along the $(-Z)$ direction.

→ Moving of a charged particle in a uniform magnetic field :

(into the page)

$\vec{V} \perp \vec{B}$ (To the center)

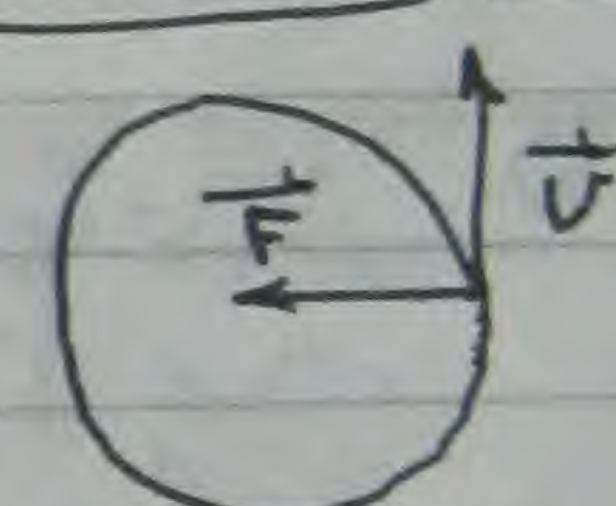
- By the right hand role
  $\vec{F}$ is directed upwards



- It represents circular motion.

q (+ve) charge

circular motion



- $\Sigma F = F_{cent.}$

$\because \Sigma f = F_B = qVB$

$$\Rightarrow qVB = \frac{mV^2}{r}$$

$\Sigma F = F_{cent} = m\frac{V^2}{r}$

$$\boxed{r = \frac{mV}{qB}}$$

Radius of the circular motion.

speed : magnit.
velocity : vector

Note:
$S = r\theta$
$V = \omega r$
$\frac{qB}{m} = \frac{V}{r} = \omega = \frac{2\pi}{T} = 2\pi f$

- F_B will affect ;
  → velocity ✓ $(\vec{V})$
  → speed ✗ (V)
  → Kinetic energy. ✗ $(\frac{1}{2}mV^2)$
  → momentum ✓ $(m\vec{V})$

- F_B has an effection on velocity not speed!